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April 16, 1959

Dear Sir:

This summary letter report describes the work done under Work Order No. I, Task Order No. CC, during the period from November 18, 1958, through February 17, 1959.

Under this program, an investigation was made on selected modifications for the 10 preproduction rectangular-cross-sectioned underground-burial containers developed under Task Order No. S. The modifications included incorporating a stiffener and bumper to protect the closure end of the container from damage if the container were accidentally tipped over, and selectively changing the closure mechanism. The 10 preproduction containers were modified in accordance with the results of this research, and working drawings of the finalized design were revised.

Included in this report are also suggestions in regard to fabrication that may be of assistance to you in any future procurement program.

Engineering Activity

On July 8, 1958, a meeting was held with you to discuss the design of the rectangular-cross-sectioned containers developed under Task Order No. S. At that time, we found that, when an empty container was tipped over from a vertical standing position onto a concrete

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floor and landed on the protruding latch hinges, the hinges were damaged and the closure was distorted enough to prevent proper sealing. As a result, it was mutually agreed that some type of stiffener-bumper structure should be provided; this would serve to stiffen the top of the container and also to provide a resilient member, such as a rubber strip, to absorb the shock incurred if an empty container were accidentally knocked over or dropped in service. Also, you suggested that further consideration should be given to the closure mechanism; effort should be directed toward eliminating the clearance space between the closure mechanism and the lid when the closure was in the latched position, so that the latch could not be used as a handle for dragging or carrying the container.

Work Order No. I, Task Order No. CC, was undertaken on November 18, 1958. This program was concerned with the investigation of the selected modifications for the preproduction container; the modification and subsequent testing of 10 preproduction containers; and the revision of the working drawings to include all of the desirable resulting design changes.

Container Modifications

Although the investigation of the selected modifications for the preproduction container were interrelated, the effort performed is discussed below in three phases, for clarity.

Stiffener-Bumper Design. The first phase of this investigation was concerned with the design of a combination stiffener

and bumper to protect the closure end of the container from damage in case of an accidental fall. A number of ideas including the use of a heavy molded rubber bumper were considered. However, it was mutually decided that the simplest and sturdiest structure would be a formed channel stiffener with a heavy rubber tube fastened in the channel like a tire. Figure 1 shows the channel-stiffener and tire-bumper design incorporated on the container. The channel, of 15-gage Type 316, stainless steel, was spotwelded to the shell of the container just below the weld joint between the shell and the flange.

Evaluation tests of the new stiffener-bumper design were very satisfactory. We found no evidence of damage of the closure mechanism and/or distortion in the flange after the container had been dropped onto a concrete floor six times.

Hinge Modification. The second phase of the modification program was concerned with the elimination of the dog-legged closure-mechanism hinges used previously in the preproduction container, as illustrated in Figure 2. One method of eliminating the dog-legged hinges would be to notch the lips of the flange and lid so as to provide clearance within which straight hinges could operate. This method, however, was found by previous research to be unsatisfactory because the notches weakened the flange and lid, and resulted in excessive distortion during the pressure test.

After studying this problem, we found that, if the wire hinge was replaced with a formed sheet-metal hinge, we could eliminate the dog-legged projection, simplify the hinge construction,

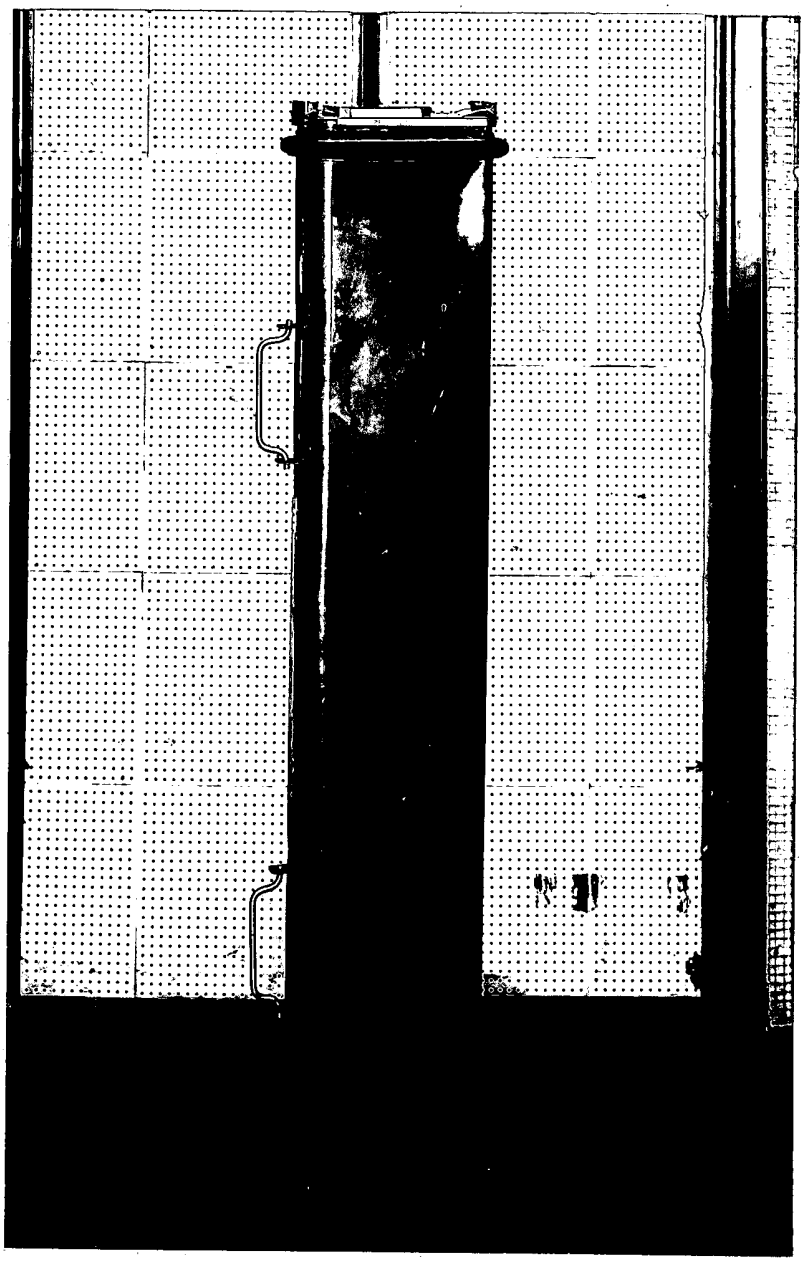

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Figure 1. Preproduction Container as Modified under Work Order No. I, Task Order No. CC

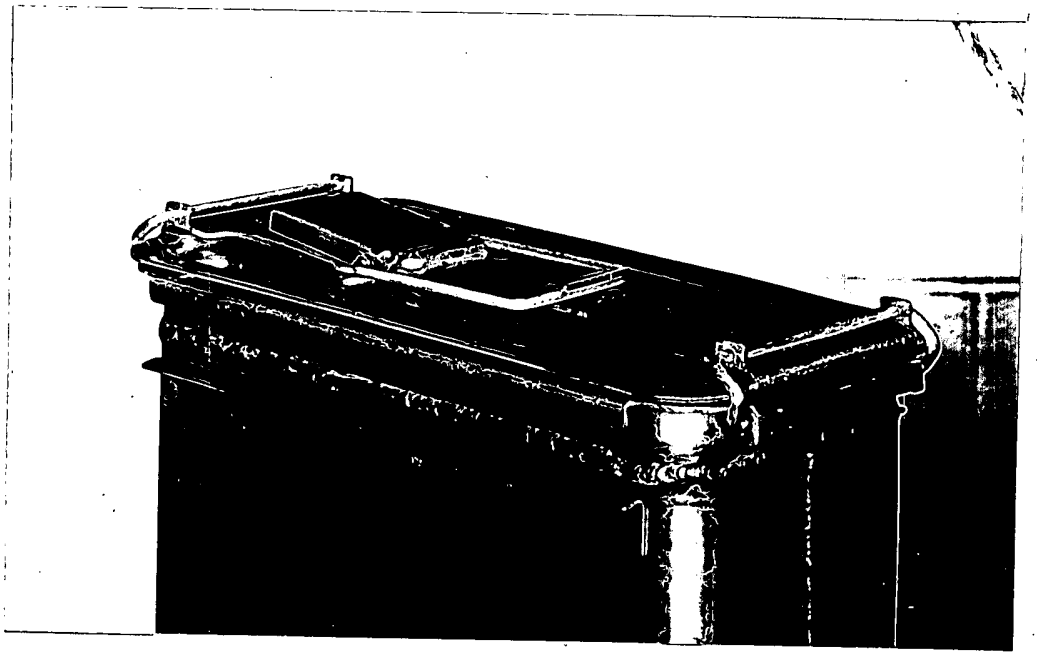

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Figure 2. Previously Developed Closure Mechanism

and eliminate the hinge tabs from the closure-mechanism levers. The removal of these tabs also simplified the fabrication of the levers. Figure 3 shows the new formed sheet-metal hinges, which were formed from 11-gage Type 316 stainless steel.

Evaluation of the new hinge design indicated that the lid could be removed or inserted into the container more easily than had been possible with the previous design. Also, the new hinge design minimized the possibility that difficulties might result from accidental dropping of the container.

Latch Modification. The third phase of this effort involved a study of the closure-latch design. Figure 2 illustrates the latch design previously used on the preproduction container. As shown, the latch loop which secured the ends of the two levers did not lie flat against the top of the lid. As a result, the loop could possibly be used as a handle for carrying or dragging the container in the field. Under these circumstances, the closure mechanism might be damaged, and also the lid might be forced out of the container; both of these possibilities are undesirable.

In order to eliminate this problem, the latch was redesigned so that the loop was covered completely, and the sides of the latch were slanted out. The new latch design is illustrated in Figure 3.

In addition to the above safety features, the new latch design provided an overcenter latching action which was approximately three times more effective than that of the previous design. Thus, this more secure latch will minimize the possibility of accidental

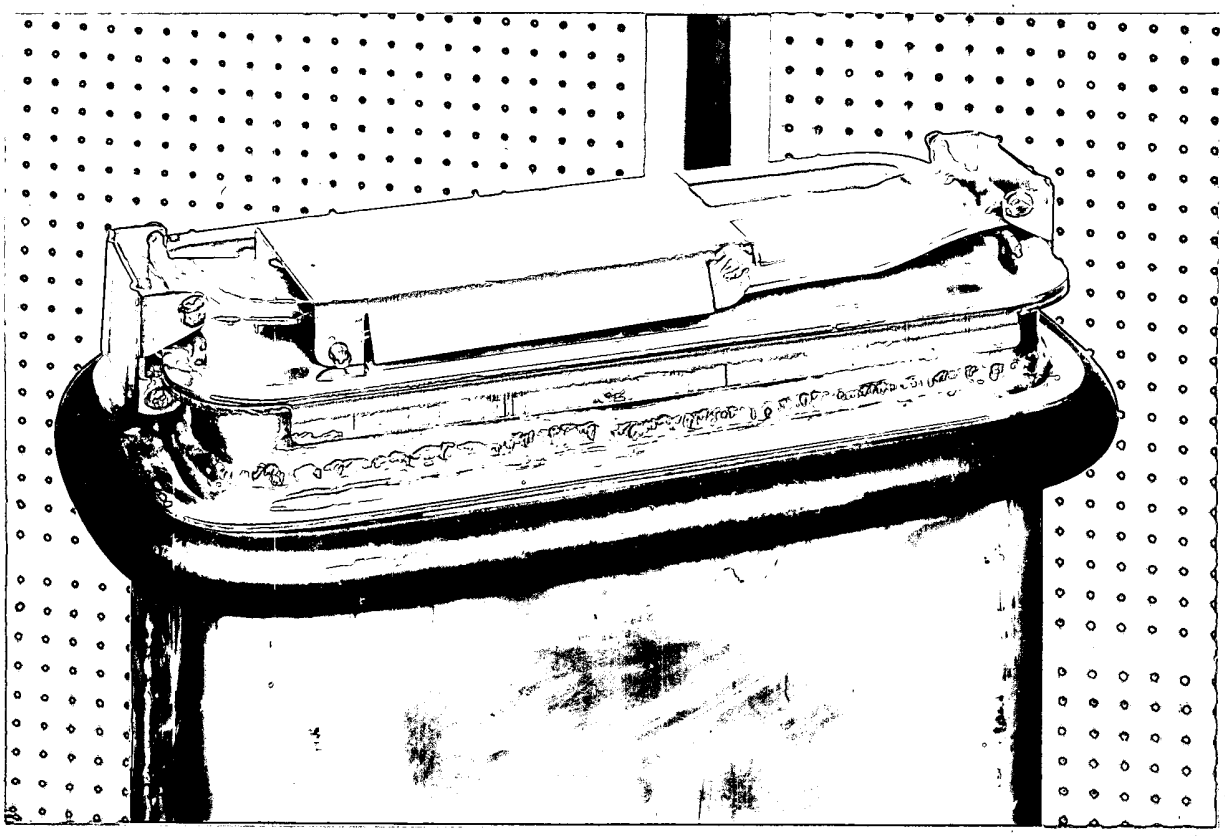

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Figure 3. Modified Closure Mechanism

opening even when it is struck by a glancing blow or when the container is dropped on the closure end.

Container Fabrication

No major problems were encountered during the fabrication of the parts modified to incorporate the changes described above or during the assembly of the 10 modified preproduction containers. However, after completing the units and subjecting them to the hot-water leak test, we found that eight of the containers leaked around the O-ring seal. A subsequent dimensional check of the flanges of these containers revealed that the 4-inch width dimension had increased considerably and that the 9-inch length dimension was undersized.

As a result of these findings, we rechecked the assembly techniques which had been used for the 10 containers. It was found that a jig had not been employed when the hinge brackets had been welded to the flanges on the eight containers which leaked; however, the two containers which showed no leakage had been jigged during welding.

In order to rectify this distortion, we re-sized the flanges with a small hydraulic jack, and by this method were able to adjust seven of the eight containers so that they no longer leaked. The eighth container was labeled as a demonstrator, in accordance with your request.

Leak Testing

When the re-sizing of the flanges of these eight containers was finished, the nine non-leaking containers were again leak tested, using the hot-water and also the underwater pressure-cycle method. For the hot-water tests, the containers were cooled to approximately 20 F and then immersed in hot water at a temperature of about 155 F. This temperature differential produced an internal container pressure of approximately 4 psi. No leaks were found in the nine containers by this method.

The underwater pressure-cycle tests were conducted in the same manner as were those under Work Order No. XIII of Task Order No. A; the procedure was described in detail in our summary letter report dated October 18, 1957. In these tests, the pressure within the containers was cycled between 3-1/2-psi pressure and 3-1/2-psi vacuum; a special lid was used in the containers during testing. None of the nine containers exhibited leakage in this test.

As was stated in our proposal dated October 21, 1957, that led to the effort under Task Order No. S, we had originally intended to leak test the rectangular-cross-sectioned containers also by a third method, namely, the helium - mass spectrometer method. This method was not used, however, because we found after testing one of the containers that the sensitivity of this method when applied to this type of container was far below that of the other two methods. The reason underlying the low sensitivity of the helium test was that we could not evacuate the rectangular-cross-sectioned container to a

low enough level; actually, it was not possible to evacuate the container to a level below about 11-1/2-psi vacuum without collapsing the container. For good accuracy and sensitivity, the helium - mass spectrometer method of leak testing should be used in systems involving a vacuum of 1/10 psi or less; this level is about 1/100 of that achievable in the rectangular-cross-sectioned container without collapsing the unit.

Revision of Working Drawings

After completing the fabrication and leak testing of the 10 preproduction containers, we revised the working drawings for the container that had been prepared under Task Order No. S. The revised drawings included all of the changes which were made in the container under this program.

Production Suggestions

During the fabrication and assembly of the parts for the 10 modified preproduction containers, we encountered some problems which merit consideration from a production standpoint, particularly if at some time in the future your organization becomes interested in procuring quantities of this type of container from commercial sources. Problems such as deformation of the parts during welding and the need for selective assembly can be avoided in the production of this type of container if certain steps are followed during the fabrication and assembly of the units.

The problem of deformation during welding can be circumvented if welding jigs and fixtures are used during all of the welding operations. The use of a jig is especially necessary in order to prevent the flange from distorting when the flange is welded to the shell or when the hinge brackets are welded to the flange. Since the sealing effectiveness of the O-ring is governed by the maintenance of the proper dimensional clearance between the flange and the lid, any significant distortion of the flange caused by welding could prevent proper sealing.

In the preparation of the preproduction containers, we spotwelded the channel stiffeners to the shell. This procedure was effective; but, it necessitated hand fitting or selective assembly of channel to shell in order to obtain a good fit between these parts, because of the large dimensional tolerances which had been allowed in the forming of the shells.

One way to eliminate any need for selective assembly would be to reduce the allowable dimensional tolerances of the shell. This restriction, however, would create added difficulties in the fabrication of the shells. Consequently, it is suggested that, in any future production of this type of container, the vertical sides of the flanges should be made longer so that the channel stiffeners can be spotwelded to the flanges rather than to the shells. Thus, since the flanges are hydroformed parts which can be produced readily to close dimensional tolerances, there would be no need for selective assembly.

The only associated change which would be required in order to increase the length of the flanges would involve specifying that

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Flange Forming No. 1 (Drawing No. 330-301 of the working drawings) should be formed to a greater depth, i.e., to a depth of $2.875^{\pm 0.010}$ inches instead of $1.687^{\pm 0.010}$ inches. There would be no problem in obtaining this extra depth of draw if the part were formed in a 19-inch Hydropress. We did not use the deeper drawn part in the preparation of the 10 preproduction containers because a 19-inch Hydropress was not available in our area of the country at that time. (However, a press of this type is available now.)

In addition to the above advantages to be gained from utilizing a deeper drawn flange, there would be no need to form an extra part for the container bottom as has been done for the 10 containers. The container bottom and the flange could be obtained from the same deeper drawn part.

The 10 modified preproduction containers were shipped to you on January 30, 1959. The working drawings will be transmitted in the near future. We have enjoyed working on the development of this container design for you, and, if we can assist further, please let us know.

Sincerely,

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